DOE FINAL REPORT

Title: ***Pathways and Mechanisms of Ocean Tracer Transport: Implications for Carbon Sequestration***
Project ID: 0009592
Program Manager: Jeffrey S. Amthor
PI: John Marshall
Award Register#: ER63679 0009592

This funding enabled the following published manuscripts in which we have developed models of direct relevance to ocean carbon sequestration and of the oceanic iron cycle, its connection to the global carbon cycle, and the sensitivity of atmospheric carbon dioxide to the external source of iron. As part of this process we have developed the adjoint of the MIT ocean biogeochemistry model which has enabled us to perform rigorous and efficient sensitivity studies.

KEY FINDINGS

Key suggestions from these models are:

(i) On decadal to centennial timescale the sensitivity of air-sea exchange of carbon dioxide to iron addition is greater, mole/mole, in the Equatorial Pacific than anywhere else in the ocean, including the Southern Oceans which are significantly controlled by light.

(ii) Artificial iron addition to the oceans is unlikely to be a successful strategy for deliberately offsetting anthropogenic fossil fuel carbon dioxide release.

(iii) Atmospheric carbon dioxide levels are much more sensitive to a decrease in aeolian iron deposition than an increase, relative to todays system.

Dutkiewicz, S., P. Heimbach, M.J. Follows and J.C. Marshall (2006) Controls on ocean productivity and air-sea carbon flux: an adjoint model sensitivity study. Geophys. Res. Lett., 33(2), L02603, 10.1029/2005GL024987

Parekh, P., S. Dutkiewicz, M.J. Follows and T. Ito (2006) Atmospheric carbon dioxide in a less dusty world. Geophys Res. Lett., 33, L03610, doi:10.1029/2005GL025098

Hill, C.N., V. Bugion, M.J. Follows and J.C. Marshall (2004) Evaluating carbon sequestration efficiency in an ocean model using adjoint sensitivity analysis. J. Geophys. Res., 109, C11005, doi:10.1029/2002JC001598.

In addition we have submitted the following manuscript detailing the feasibility of offline modeling of ocean tracers at high resolution:

Hill, H., C.N. Hill, M.J. Follows, S. Dutkiewicz (2006) Is there a computational advantage to offline tracer modelling at very high resolution? Submitted to Ocean Modelling.